

Pest Management Grants Final Report

Contract # 97-0247

Hedgerows: Turning Farm Waste Areas into Active IPM Life Cycles

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Table of Contents:

Page Number

I.	List of Figures	3
II.	List of Tables	3
III.	Abstract	4
IV.	Executive Summary	4-5
V.	Introduction	6
VI.	Materials and Methods	7
VII.	Results and Discussion	9
VIII.	Summary and Conclusions	11
IX.	Addendum – City of Davis Hedgerow	14
X.	References	15

List of Figures:

- Figure 1:** Total cost of installing and maintaining four Yolo County hedgerows
Figure 2: Survivorship of hedge plant species for all sites combined
Figure 3: Survivorship of hedge plants by site
Figure 4: Management practices and cumulative costs over time
Figure 5: Hedgerow plant growth by site
Figure 6: Average cost (%) of hedgerow establishment, by cost category
Figure 7: Average cost (% and \$) of establishing four hedgerows in Yolo County
Figure 8: Recommended cost (%) of hedgerow establishment, by cost category

List of Tables:

- Table 1:** Cost Estimates for Installation and Maintenance of a “typical hedgerow”, by task and time of year

Abstract

Four “insectary” type hedgerows for augmentation of beneficial insects were planted in Yolo County in 1996 on large-scale rotational field crop farms. Establishment practices and costs were documented at each site for two years. This information was used to develop model guidelines for establishing a 1,500 foot-long hedgerow on field crop farms. These practices and corresponding costs fall into five categories; 1) site preparation, \$350, 2) hedge plants, \$685, 3) perennial grasses, \$385, 4) weed control, \$1,045, and 5) irrigation, \$760, for a total of \$3,225. Although hedgerows take time and money to establish, their numerous benefits can potentially offset these costs.

Executive Summary

California farmers interested in sustainable agriculture have been planting “insectary” hedgerows on their farms in order to attract beneficial insects and provide wildlife habitat. However, adoption of these hedgerows has been very slow, in part due to the non-existence of information about where and how to plant these hedgerows, the management practices that are necessary, and the costs associated with these practices. The purpose of our research was to develop management practices and costs for establishing “insectary” hedgerows on field crop farms.

Four “insectary” hedgerows were planted on Yolo County field crop farms in the fall and winter of 1996. These demonstration sites were selected based on diversity of soil type, site location, and farmer practices. Hedgerows were planted in a rectangular design on field edges; sites were adjacent to canals, fences, and roads. This design was chosen as it was found to be the easiest to manage using standard farming equipment (discs, harrows, mowers, etc.). The hedgerows ranged in length from 975’ (March’s) to 1,855’ (Fong’s), and width was standard at 15’.

Hedge plants used were perennial California species, as they are highly adaptable to environmental conditions, and require little or no irrigation after two years. Plants were also chosen with a range of flowering periods, so that beneficial insects would have pollen and nectar resources most of the year. After planting, weeds were controlled through the use of spraying, flaming, and hoeing. Native perennial grasses, an important component of hedgerows, were planted soon after the hedge plants. A mix of five-six species of perennial grasses was used because each species has different environmental optima and tolerances, so different grasses predominate in different areas of the hedgerow. The grass mix was also selected based on the site soil type. Grasses were broadcast seeded in the fall, and weeds were controlled using Roundup® and mowing.

Irrigation of the sites began in the spring, three sites with drip and one site with furrow. Drip irrigation is preferred, as water can be closely monitored as hedge plants grow larger and require less irrigation. We monitored the hedge plants for survivorship and plant growth for two years post-planting in order to determine if there were differences among sites and soil types.

We collected cost information for the duration of the study in order to determine recommended establishment practices and costs to establish an “insectary” hedgerow. Costs for establishing each hedgerow, including percent cost for each category, are shown in Figure 1. Meeks’ cost \$4,613, Fongs’ \$4,577, Marchs’ \$3,836, and Harlans’ \$3,202; this averages \$4,056 for 1,326 feet. Our recommended costs for a 1,500’ hedgerow are lower at \$3,235 (Table1).

Site preparation averaged 8% of the total cost, despite differences in site length, due to fixed costs for equipment. Hedge plants averaged 20%, although recommended costs are lower due to increased knowledge about how, when and where to plant certain species. Based on our plant survivorship data, we know which plants are sensitive to root rot and should not be planted in heavy soils. Perennial grasses averaged 19% of total hedgerow cost, and were high due to the necessity of replanting at three sites.

Weed control averaged 33% of the total cost, but once again our recommended costs are lower due to our increased knowledge of how and when to control weeds. The use of Ronstar®, a preemergent herbicide, greatly reduced the weed pressure in the second year, thereby reducing our hoeing costs. Vertebrate pest control averaged 4%, and 95% of this cost was for tree tubes, which we don’t recommend unless there is high mammal pressure in the area. Irrigation costs averaged 16%, with the drip being more expensive than furrow.

Establishing hedgerows takes good planning and design, and integration of the hedgerow practices with general farming practices will lead to the most success. We found that sites alongside fields, rectangular in shape with hedge plants down the middle and grasses along each side or hedge plants on one side with grasses on the other, were the easiest to manage and the most adaptable to farming practices. Care should be taken to select plant species that are adapted to your soil type, as many chaparral plants require good drainage. If soil types are heavy, there are many other plant species that should be used. Plants need to be ordered at least six months in advance of planting; fall is the best time to plants both hedge plants and grasses.

Weed control is the most critical management practice, as weeds will quickly outcompete hedge plants and grasses if they are left unchecked. Weed control can be done in a number of ways, depending of farming compatibility and time of year. Preemergence materials have proved to lessen weed control expense considerably, and hedgerow growth is impacted favorably. Irrigation is one of the most difficult management practices, as drought-tolerant plants are very sensitive to overwatering. For this reason, we recommend drip irrigation, but care should be taken to monitor the plants for signs of root

rot and water stress. Emitters should be removed when plants are large enough to survive on their own (usually after two years). Where they are problems with rodents and deer, tree tubes can be used. However, plants quickly outgrow tubes and they should be removed before plant girdling occurs.

The biggest cost in establishing hedgerows is for hedge plants and grasses followed by weed control and irrigation. As we move to our third year of documenting costs, we expect to shift to a maintenance program with minimal costs. Insectary hedgerows are expensive to establish and we still do not know the full extent of their impact on pest control. However, hedgerows do provide habitat and food for beneficial insects and wildlife. Additional benefits include use as filter strips, wind breaks, dust barriers, reduced soil erosion, and weed control of field edges.

Introduction

Hedgerows are rows of trees, shrubs, or grasses that enclose or separate fields; they are a product of direct plantings, relics of cleared lands, or a result of dissemination by birds. Hedgerows are mainly dependent on agricultural activities and persist in the landscape when farmers manage them (2,8).

Hedgerows have been in existence for over a thousand years, and have been used for windbreaks, fodder, fuel wood, religious and medicinal purposes, protection, creating boundaries, and fencing livestock (11, 26). More recent studies have shown additional benefits to include habitat and food for wildlife and beneficial insects, weed suppression, water conservation, nutrient enrichment and retention, reductions in air, water and noise pollution, wind damage and soil erosion (3, 4, 5, 10, 11, 16, 19).

Despite these benefits, there has been a drastic decline worldwide of the number and length of hedgerows since the 1940's (29). Fields have been enlarged to facilitate the use of large machinery, leading to the removal of shrubs and trees that delineated previously small fields. This has led to increased environmental problems such as soil erosion and wind damage, and a loss of biodiversity in intensively cultivated areas (7, 9).

California farmers interested in sustainable farming have been planting "insectary" hedgerows to attract beneficial insects to farms for biocontrol of pests in adjacent crops (5, 13, 17, 18, 23, 24, 25). However, adoption of hedgerows is slow, in part because there is very little information on establishment practices and costs. These are important to develop because the suitability of hedgerows for different purposes and ease of management depend on their size and the plant species they contain (1, 5, 15, 22). In addition, poorly designed hedgerows are difficult to manage and they can be sources of crop pests, including weeds, diseases, insects, and rodents (20, 28, 30). The purpose of our research was to develop management practices and costs for establishing "insectary" hedgerows on field crop farms.

Materials and Methods

Site preparation

Four “insectary” hedgerows were planted in Yolo County in 1996 on large-scale rotational field crop farms. Sites were selected by choosing areas adjacent to crops that were not being farmed, but where equipment access to the area was possible. Meek’s site is along a drain ditch on silty clay, saline-alkali soil (Pescadero); Fong’s is along a fenceline on silty clay loam (Brentwood); Harlan’s is between a ditch and a canal on the same soil type as Fong, and March’s is under a pole line on silt loam (Yolo).

We made each hedgerow rectangular, because Hedgerow Farms found this design easiest to manage using standard conventional farming equipment. Sites were prepared by disking and shaping an area and making a seedbed in the fall. Meek has four, 5 foot beds (1,275 feet long) with furrows for flood irrigation; the outside bed is for hedge plants and the others for perennial grasses. Fong has one raised bed for hedge plants and a 10-foot wide seedbed for grasses, both 1,855 feet long. Harlan’s (1,200 feet by 15 feet) and March’s (975 feet by 15 feet) were planted on flat seedbeds, with the hedge plants in the center of the grass stand.

Hedge plants

Hedge plants include Willow (*Salix spp.*), California lilac (*Ceanothus spp.*), Yarrow (*Achillea millefolium*), Coffeeberry (*Rhamnus californica*), Hollyleaf cherry (*Prunus ilicifolia*), Soapbark tree (*Q. saponaria*), California buckwheat (*Eriogonium fasciculatum*), Blue elderberry (*Sambucus mexicana*), Toyon (*Heteromeles arbutifolia*), Narrowleaf milkweed (*Asclepias fascicularis*), Coyote brush (*Baccharis pilularis*), California buttonwillow (*Cercis occidentalis*), and Deergrass (*Muhlenbergia rigens*). These plants bloom at different times so that there is continual flowering from February to November. Plants were also chosen for their perennial habit, drought tolerance, and ability to outgrow weeds.

Hedge plants were obtained as tree bands and primarily planted in the fall. Larger growing shrubs and trees were planted 10-15 feet apart, whereas small ones were planted at a five-foot spacing. Agriform orchard fertilizer tablets® (20-10-5) were used with larger shrubs at time of planting.

Weeds in the hedge plant row were controlled by hoeing, flaming, or spot treatments with Roundup® and 2,4-D, and by placing 9ft² weed mats (VisPore tree mats®) around hedge plants. In the second year, Ronstar® (Oxadiazon, a pre-emergence herbicide) was applied around hedge plants at the March, Meek, and Harlan sites. Chemicals were not used at Fong’s because this site is being farmed organically.

Perennial grasses

The perennial mix includes Purple needlegrass (*Nassella pulchra*), Blue wildrye (*Elymus glaucus*), Meadow barley (*Hordeum brachyantherum*), Yolo slender wheatgrass (*Elymus trachycaulus majus*), California brome (*Bromus carinatus*), Creeping wildrye (*Leymus triticoides* 'Rio'), and Oniongrass (*Melica californica*). This mix was chosen because each species has different environmental optima and tolerances (6), so certain grasses predominate in different areas of the hedgerow. At Meek's site, we did not include brome, wildrye, and oniongrass because these do not tolerate alkali soil conditions.

The grass seed was broadcast in the fall at 30 lb/acre, then harrowed to cover seed to a depth of 1/8 inches. At Fong's, the seedbed was pre-irrigated in early fall, harrowed for weed control, then planted. All other sites were planted in late fall after rain-germinated winter weeds were harrowed or sprayed with Roundup® (Glyphosate). Roundup® was applied at Meek's and March's about nine days after planting for annual weed control before the slower growing perennial grasses emerged.

Once the grasses emerged, Buctril® (Bromoxynil) and 2,4-D were used to control winter and summer broadleaves at the conventional sites; at Fong's weeds were hoed. All sites were mowed once or twice in the spring to control annual grasses before they set seed. In the second year, weeds were controlled by hoeing, flaming, mowing, and with Ronstar®. Weak areas of the stand were plug planted with small seedlings of saltgrass at Meek's site and creeping wildrye at the other sites.

Vertebrate pest control

Tubex® tree tubes were placed over the shrubs at time of planting to prevent damage by rodents and deer. These were removed the following spring because they confined the plants. At March's we set out gopher bait (Gophergetter®) three times during the 1997 growing season. At Fong's we fenced most of the one-year-old *Ceanothus* shrubs to prevent deer damage.

Irrigation

Meek's site was furrow irrigated; the other sites were placed on one inch drip lines with one gallon emitters for larger plants, and 0.5 gallon emitters for smaller ones. Harlan's irrigation system was connected to a water truck, March used well water, and Fong used an existing flood control district water transport pipe. All sites were irrigated bimonthly throughout the growing season for several hours early in the season, then up to 15 hours or more once the plants were more established. Emitters were removed from larger established plants at the Fong and Harlan sites after the first year; Fong's got enough water from adjacent alfalfa irrigation and Harlan's tapped into moisture from the nearby canal.

Survivorship and plant growth

Hedge plants were monitored for six months after planting at each site to determine if there was a difference in plant survivorship between species and between sites. This was done by counting the number alive versus the total number of plants at each site and making pair wise comparisons between plant species and between sites (paired t-test). Plants that died were removed and replaced with others the following spring or fall. Plant size (per square foot) were monitored at each site by measuring the height and width of Buckwheat, *Ceanothus*, Coffeeberry, Coyote brush, Elderberry, Hollyleaf cherry, and Toyon, at time of planting and then 6, 12, and 18 months later. These measurements were averaged by sample date for all four sites.

Cost analysis

Hedgerow establishment costs were broken down by percent of the total cost for each site, into five categories: 1) site preparation; for designing, planning, and preparing the hedgerow site; 2) plants; for hedge plants and fertilizer use; 3) grasses; for purchasing and planting seed, 4) weed control; for chemicals and application, and 5) irrigation; for drip line. Labor costs were included in these practices and set at \$10 per hour, including benefits. Farm machinery, which included tractors, discs, ATV's, and sprayers, varied from \$2 to \$20 per hour, depending on the equipment used (21).

Recommended establishment practices

Recommended establishment practices for a 1,500 foot-long hedgerow were developed by integrating the most cost efficient and effective strategies that we observed through planting our hedgerows and summarizing them by date and practice (Table 1). These data are also summarized by cumulative costs over time for the different management practices (Fig. 4).

Results and Discussion

Costs for establishing each hedgerow, including percent cost for each category, are shown in Fig. 1. Meeks's cost \$4,613; Fong's, \$4,577, March's, \$3,836, and Harlan's, \$3,202; this averages \$4,046 for 1,326 feet. Total recommended costs for a 1,500 foot-long hedgerow are lower at \$3,235 (Table 1).

Site preparation

Site preparation costs averaged 8% (\$329) of the total costs for all four sites, despite differences in hedgerow lengths. This occurred because there are fixed costs for equipment and labor in hedgerow layout. Recommended site preparation costs for our model 1,500 foot-long hedgerow totaled \$350; this is higher than the actual costs because of the added use of Roundup® for summer weed control to reduce the weed seed bank.

Hedge plants

Hedge plants averaged 20% of the total cost (\$832). Recommended model costs are lower at \$685, because we did not include replant costs; we now have a better understanding of where, when, and how to plant hedge plants. Hedge plant survivorship by species for all sites combined during the first six months after planting varied between 65% and 90% (Fig. 2, $P > 0.05$). Buckwheat and *Ceanothus* cv. Ray Hartman continue to be most sensitive to root rot and after two years we have lost 75% of these plants. At Meek's, only 60% of the hedge plants established here after six months, compared with up to 95% for the other sites (different from Fong's at $P = 0.01$, Fig. 3). Buckwheat, Toyon, Hollyleaf cherry, Coffeeberry, and *Ceanothus* cv. Ray Hartman died because they could not tolerate the heavy alkali soil; however, the other plant species are thriving. None of our spring replants survived because of heat and water stress.

Perennial grasses

Grasses averaged 19% (\$733) of the total hedgerow cost. Costs were higher than our model \$385 costs because of replanting at three sites: Harlan's was sprayed with herbicides, Meek's site planted in December when it was too cold and wet for germinating seedlings, and March's seedlings ran out of moisture (no rain in 1997 after January) and couldn't compete with annual weeds. In addition, we did a great deal of plug planting to fill in weak areas of the stand where sections were accidentally disced or sprayed; this accounted for 30% of the grass costs as seedlings cost from \$0.11 to \$1.00/plug.

Weed control

Weed control averaged 33% (\$1,349) of the total hedgerow cost for all sites combined. For our model hedgerow, costs are again lower at \$1,055. The first year, we did not use any pre-emergence herbicides at any of our sites. As a result, we had intense weed pressure that required extensive hand weeding. We also did some flaming to help control

smaller weeds. The weed mats that we used did not work because we cut them too small; in addition, they were expensive (\$2 per plant, including mat, stakes, and labor), and tended to get caught in farming equipment when discing and mowing around plants. In the second year, we used Ronstar® around our hedge plants and in the perennial grasses; this material gives excellent weed control, though hoeing was still necessary as field bindweed (*C. arvensis*), chickweed (*S. media*), and yellow star thistle (*C. solstitialis*) are tolerant.

Vertebrate pest control

Vertebrate control costs averaged 4% (\$174) of the total hedgerow cost. Over 95% of these costs were for Tubex® tree tubes (\$1.15/tube). There are no recommended costs for vertebrate pest control in our guidelines; we found that the shrubs outgrew the tree tubes too quickly to justify the expense. At time of planting, hedge plants were < 1 foot square; within several months they were >1 foot square and the tree tubes had to be removed. By the fall of 1998, they averaged 21 square feet per plant (± 3.3 SE, Fig. 5).

Irrigation

Water costs averaged 16% (\$641) of the total hedgerow cost. The drip systems average \$686 compared to furrow at \$507. Drip system costs are about the same despite differences in hedgerow lengths, because there are fixed costs for installing them. The recommended water costs for our model is \$760. We selected the drip system over furrow because it is easier to control water flows for plants susceptible to root rot. Model costs are higher than the actual costs because of more irrigations; with El Nino in 1998, we did have to water our hedgerows as often as with a normal rainfall year.

Summary and Conclusions

Establishing hedgerows takes good planning and maintenance, and work best when integrated with general farming practices. When selecting a site, it is important to find an area where there will be little or no interference from herbicide drift or accidental discing; new hedgerows are hard to see and may be confused with weedy sites (14, 27). Although there are many types of designs, we found rectangular shapes easiest to manage with standard farming equipment and are most adaptable to common farming practices. Prior to planting, weeds should be controlled for as long as possible in order to reduce the weed seed bank. At Fong's, weed control costs were lowest because this sight had excellent weed control for several years.

Since good drainage is essential for many chaparral plants including Toyon, *Ceanothus* cv. Ray Hartman, California buckwheat, Hollyleaf cherry, and Coffeeberry, care should be taken to plant these in lighter textured soils or on berms. The other recommended insectary plants seem to do fine on heavier ground. Plants should be ordered in the spring (at least six months in advance, to give time for nursery propagation) and then planted in the fall when good root growth occurs for perennials. Perennial grasses should be seeded in the fall, so that winter rains germinate the seed and seedlings have adequate root growth when the weather turns hot in the spring.

Weed control is the most important part of establishing hedgerows as uncontrolled weeds will quickly outcompete grasses and hedge plants. We found Ronstar® to be the least expensive and easiest way to control weeds in the hedge plant row in the first and second year of establishment. The disadvantage of using Ronstar® is that established plants will not be able to reseed and fill in weak areas of the stand. For example, at Fong's where we did not use any chemicals, Yarrow has spread by seed throughout the hedgerow and is helping to suppress weeds.

Pre-emergence materials cannot be used in first year perennial grass stands; instead, mowing and burning are the only options for annual grass weed control, which will also help to reduce thatch buildup. For broadleaf weed control, materials such as Buctril® and 2,4-D can be used in first year stands. In second year grass stands, a number of materials such as Ronstar® can be used (17). Plug planting with grass seedlings will help fill in gaps in weak areas of a grass stand; however, this is expensive, so recommended on a limited scale.

We found irrigation to be a very difficult part of establishing hedgerows because drought tolerant plants (depending on species) can be very sensitive to overwatering. Sandier soils require short but frequent irrigations; heavier soils the opposite. We recommend using drip irrigation for this reason; it is easier to control the amount and timing of irrigation with drip system. Emitter volume can be specific for each plant species, as well as number of emitters for each plant. Emitters should be removed from larger established plants after one year in order to reduce the likelihood of root rot. In general, hedgerows should be irrigated for two to three years after planting, at which time the plants should survive well on their own.

Where there are problems with rodents and deer, such as adjacent to riparian areas, Tubex® tree tubes should be used at time of planting. However, the disadvantages of Tubex® are that they are expensive, they confine shrubs within a few months, and they are impossible to remove if placed more than 3 inches deep. Birds may also be a problem in crops adjacent to hedgerows; in other established hedgerows, growers have observed them to move out of these protected areas to feed on the first few rows of seedling stands. To prevent bird damage to crops, it may help to have a buffer zone between the crop and the hedgerow. At all of our sites, there is a road between the hedgerows and the crops; we have not observed any bird damage in seedling stands during the past two years.

The biggest cost in establishing hedgerows is for hedge plants and grasses. This is followed by weed control and irrigation. As we move into our third year of documenting hedgerow costs, we expect to shift to a maintenance program with minimal costs. Irrigations will not be necessary because the plants are well established. In addition, weed control costs should decline because the hedge plants and grasses are filling in open areas where weeds predominate. Eventually we expect to see all hedgerow costs minimized; for example, at Hedgerow Farms, John Anderson spends < \$100 per year for maintenance of his 15 year-old hedgerows.

Insectary hedgerows are expensive to establish and we are still in the process of evaluating their impact on pest control in adjacent crops. However, we do know that hedgerows provide habitat and food for beneficial insects and that these insects use the floral resources and move into adjacent crops (18), possibly enhancing biocontrol of pests. Additional benefits of hedgerows around farms include reduced wind damage to crops, decreased costs associated with weed control on farm edges, less soil erosion, wildlife habitat, and enhanced air and water quality.

Addendum - City of Davis Hedgerow

The fifth and final hedgerow planted was the City of Davis hedgerow in October 1996. The purpose of this hedgerow was to serve as an educational site for city personnel and urban residents. Due to the fact that it is not located on a rotational field crop farm, it was not included in the data analysis for the hedgerow cost study and best management practices. All labor completed on this hedgerow was performed by City of Davis employees, and under much different circumstances than the other four hedgerows. The City of Davis has greater resources and knowledge about native plants than do the majority of Yolo County farmers, as they have planted a great deal of city property to native perennials. In addition, their costs are much different than a typical Yolo County farmer and we did not feel that it would be appropriate to include their costs in our overall study.

However, hedgerow design and management practices for this hedgerow were virtually identical to the other four. The hedgerow is rectangular in design; approximately 2,000 feet in length, with native perennial grasses planted along one side. Due to the fact that this hedgerow was planted a year after the other four, we were able to incorporate information that we had gleaned from prior situations. For example, we chose plant species that were best suited to the soil type of the area, as well as recommended improved irrigation schedules and weed control strategies. This increased information led to a higher survival rate of the plants in the Davis hedgerow.

The Davis hedgerow is located along a major road (Covell Boulevard) in Davis, and because of its location is highly visible to thousands of people every day. This location has made possible a good deal of local newspaper coverage (articles in two local papers on the planting by area elementary school students), as well as a media tour organized by the Western Crop Protection Association and CURES (Coalition for Urban and Rural Environmental Stewardship). It has provided a location for Davis residents to view the progress of hedgerow growth, and to learn about the benefits of planting native perennial species. The City of Davis has erected an informational booth at the hedgerow for people to view, and includes a list of species in the hedgerow, and the benefits of insectary plants to an IPM program. The City of Davis has a strong IPM program, and has done an excellent job of promoting the use of native flowering shrubs and trees for beneficial insect habitat.

The Davis hedgerow will continue to grow and become a very visual part of the landscape on Covell Boulevard. As it grows, urban residents and city officials will be able to see the benefit of planting a hedgerow for use as a buffer along agri-urban interfaces. Davis is growing substantially over the next five years, with thousands of acres of farmland being converted to housing development; the agri-urban interface will be increasing, and hedgerows should be considered as a viable buffer zone in these areas.

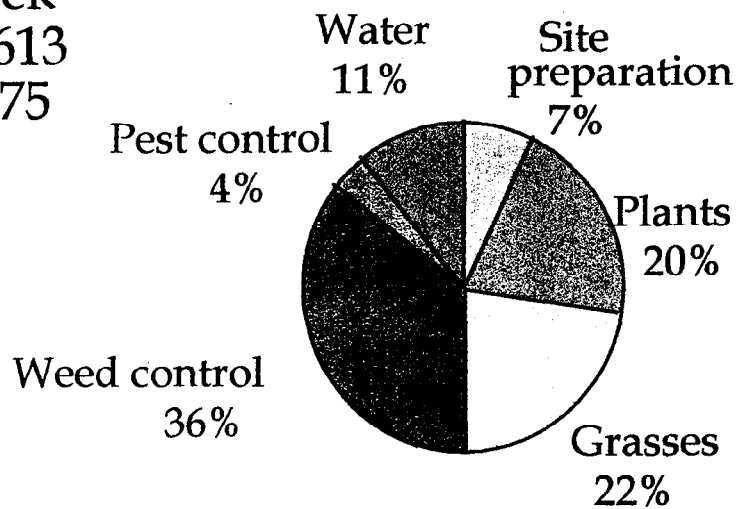
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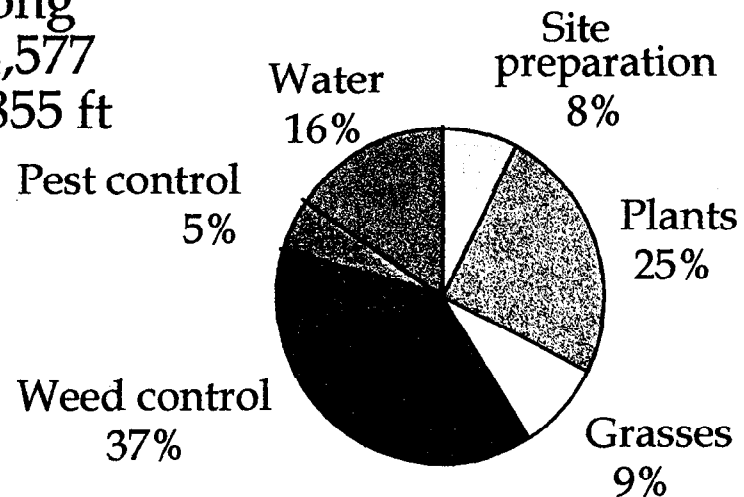
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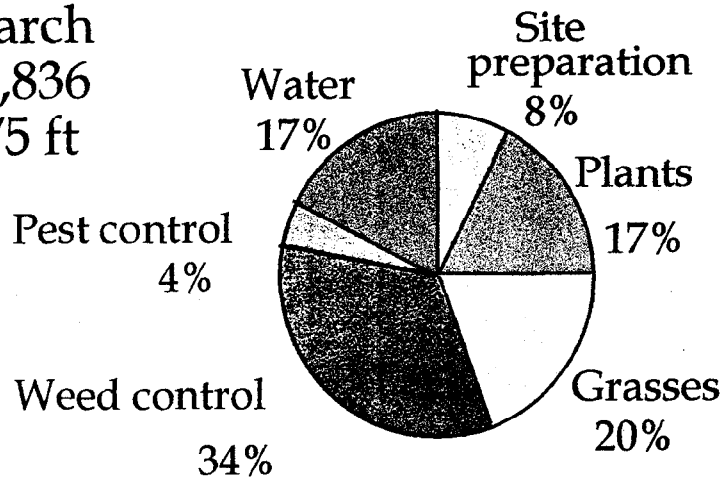
Meek
\$4,613
1,275



Fong
\$4,577
1,855 ft



March
\$3,836
975 ft



Harlan
\$3,202
1,200 ft

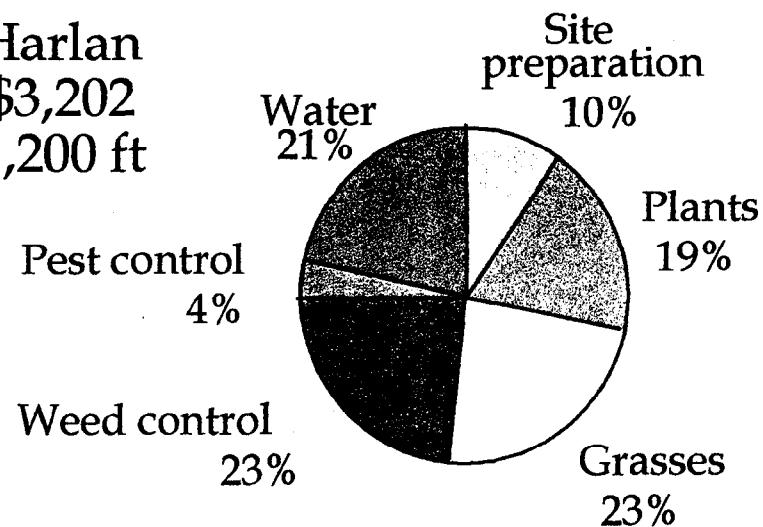


Figure 1: Total cost of installing and maintaining four Yolo County hedgerows

Survivorship of hedge plant species for all sites combined (mean % \pm SD, $P>0.05$).

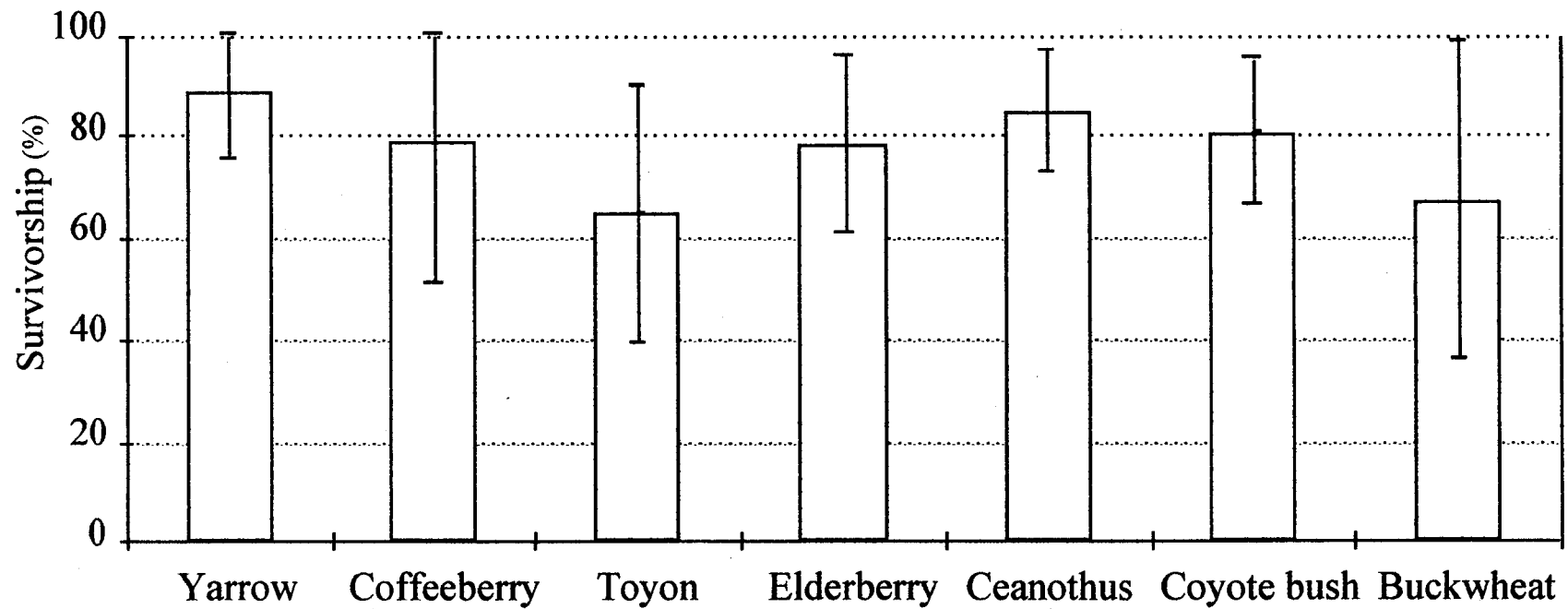


Figure 2: Survivorship of hedge plant species for all sites

**Survivorship of hedge plants by site (mean % +SD);
Meek is significantly different from Fong ($P=0.01$).**

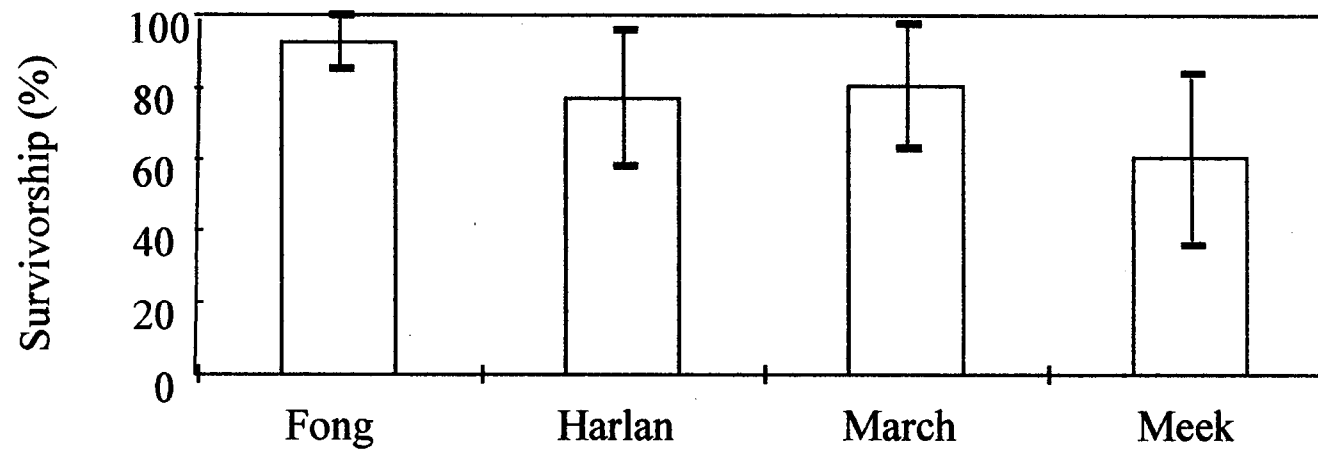


Figure 3: Survivorship of hedgerow plants by site

Management practices and cumulative costs:1,500 ft hedgerow

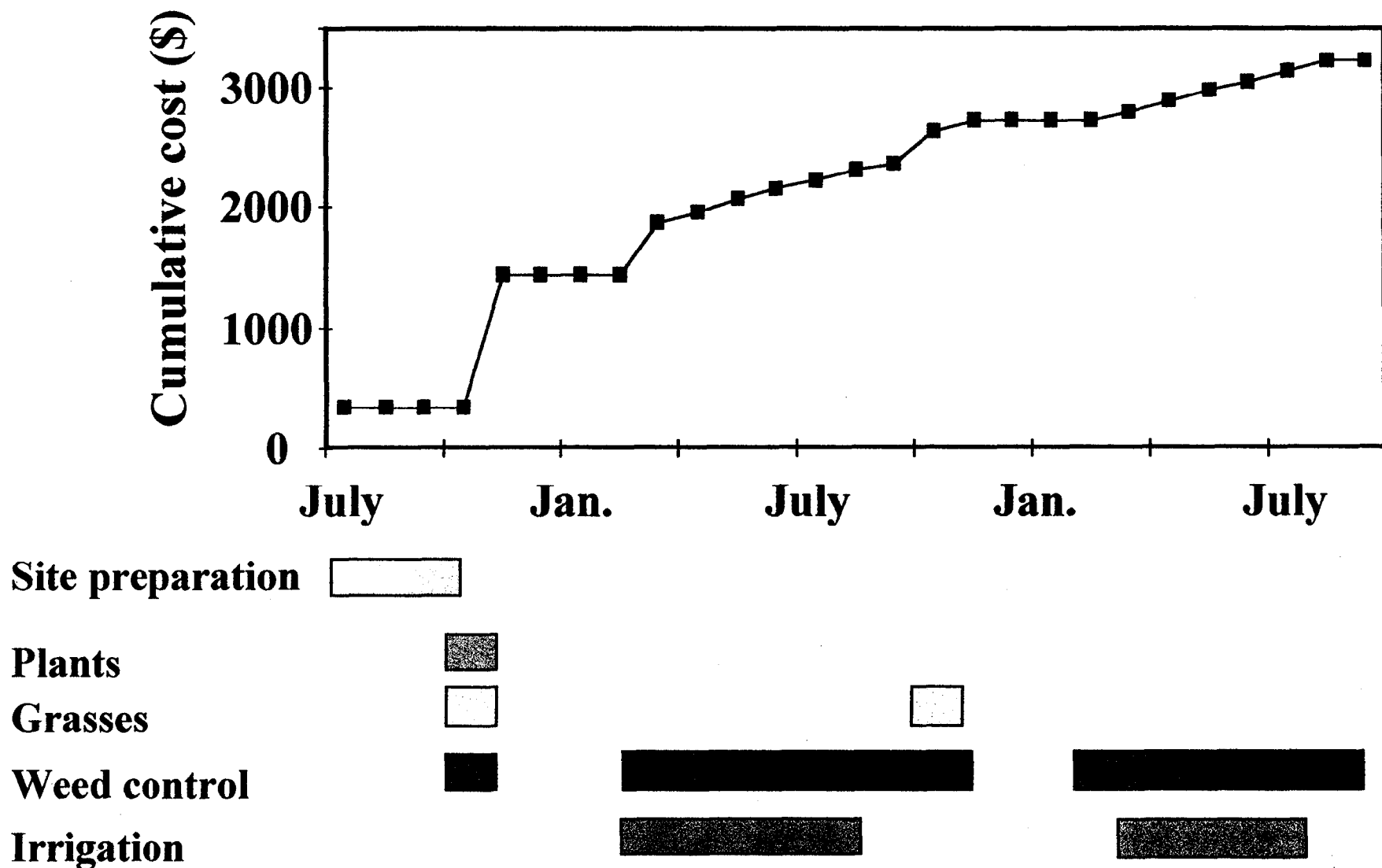


Figure 4: Management practices and cumulative costs over time

Plant growth data ($\text{ft}^2 \pm \text{SE}$) for all species and sites combined.

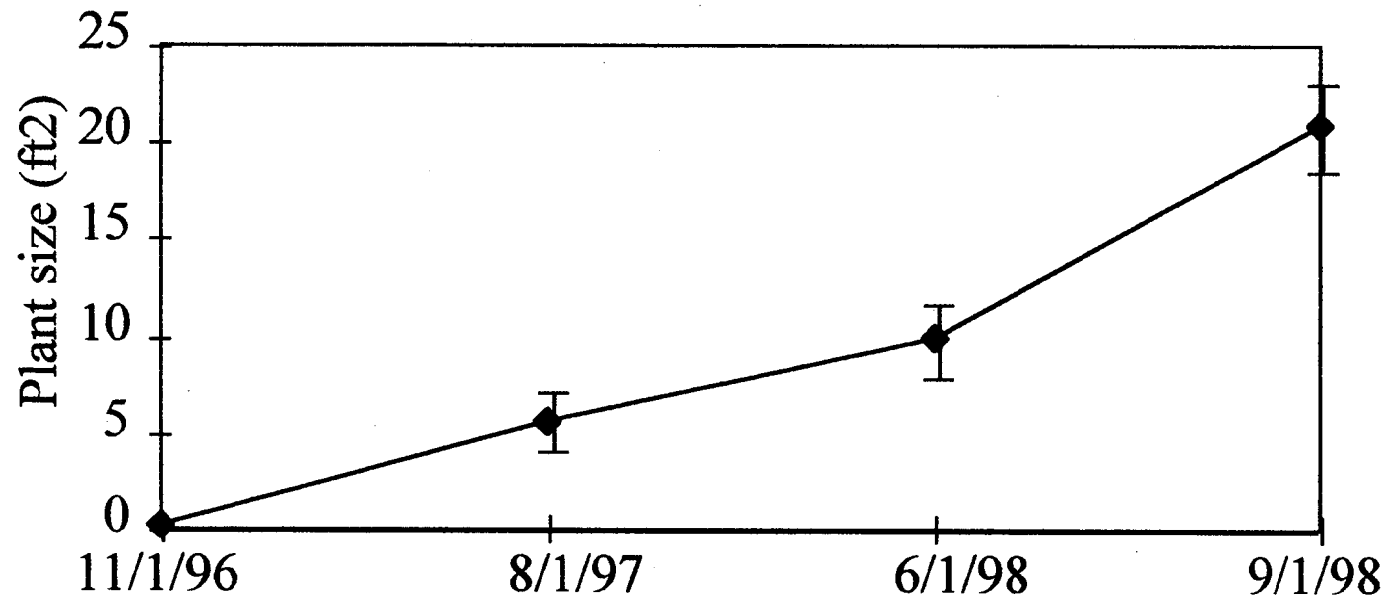
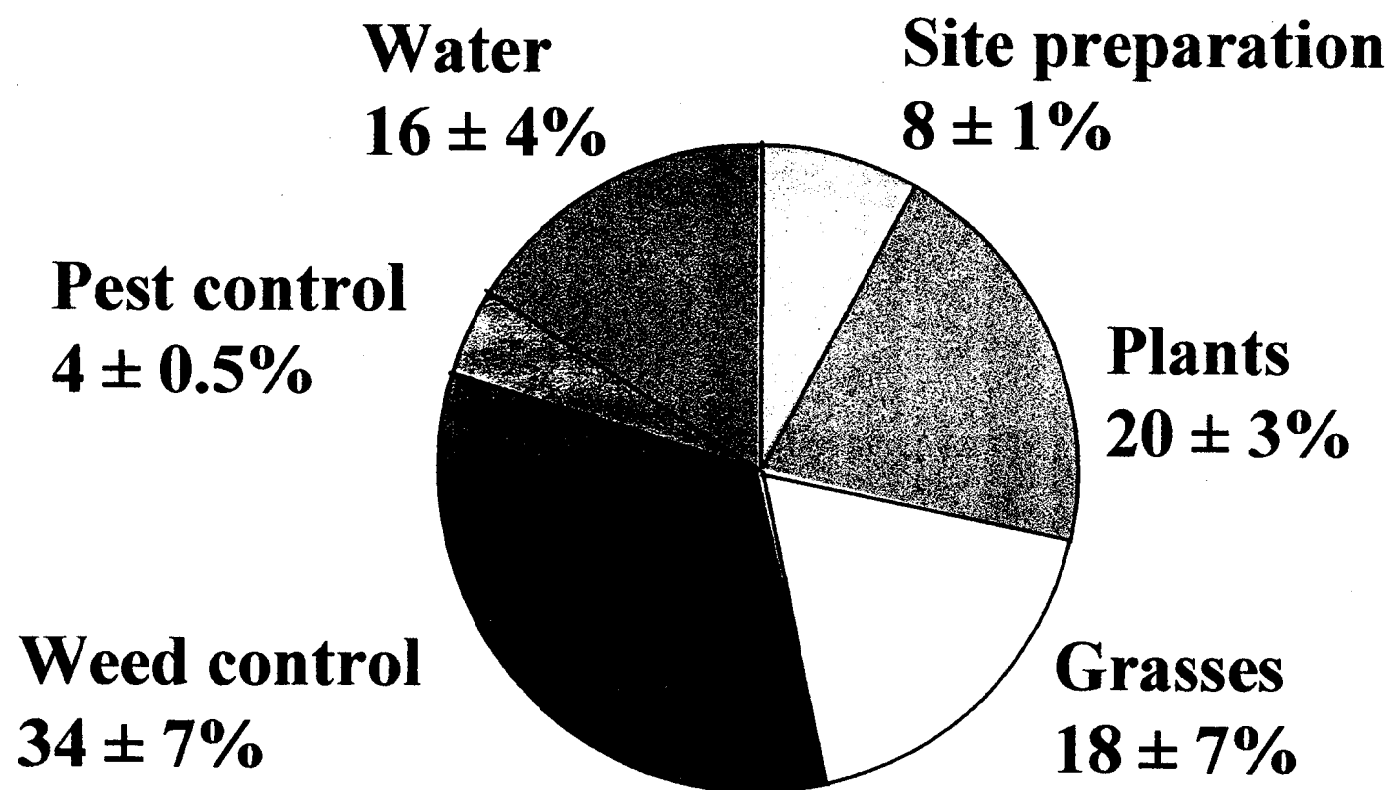


Figure 5: Hedgerow plant growth

Figure 6: Average cost (%) of hedgerow establishment by cost category

Average costs



Average costs for establishing 4 hedgerows, 1996-1998

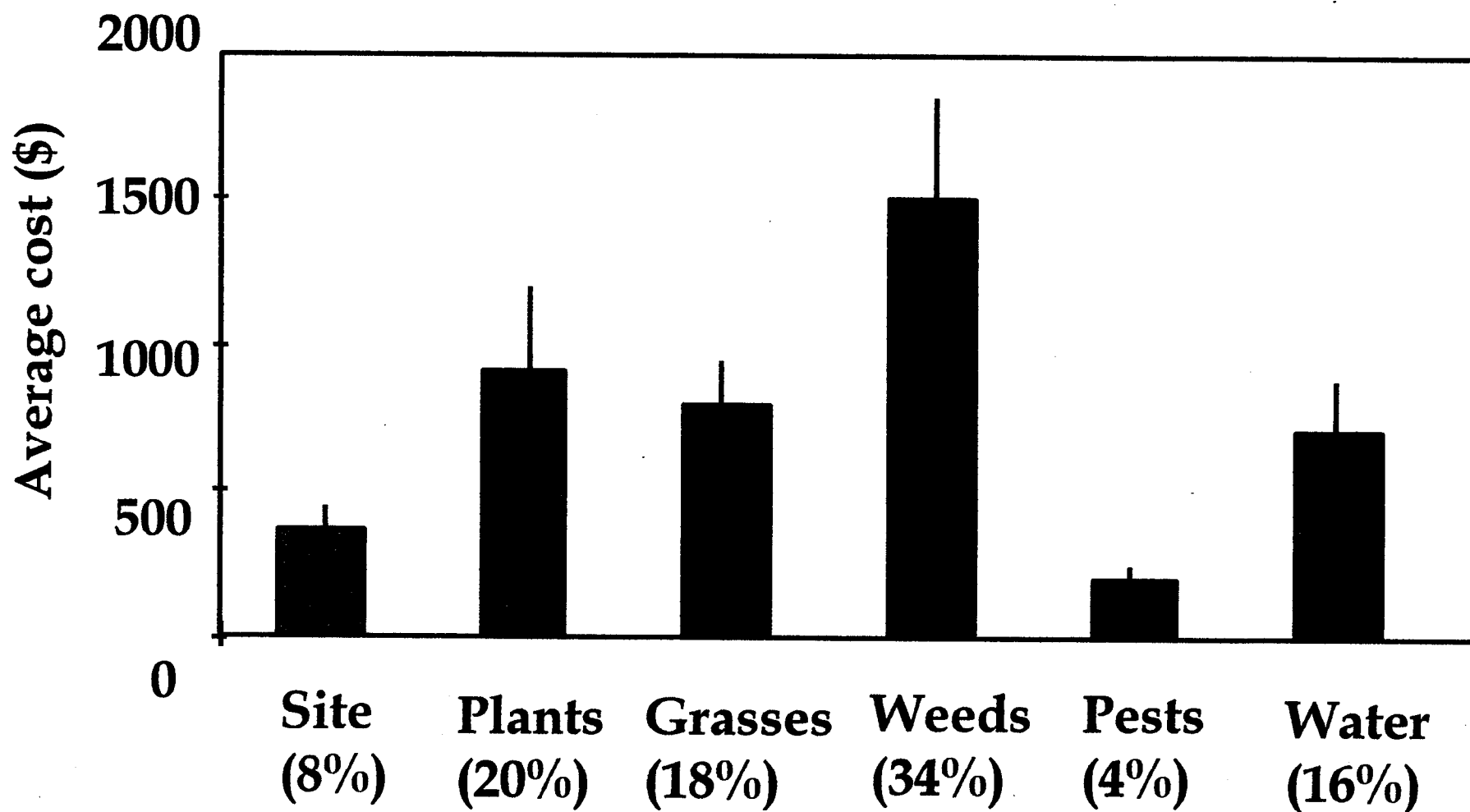


Figure 7: Average cost (% and \$) of establishing four hedgerows in Yolo County

Recommended costs

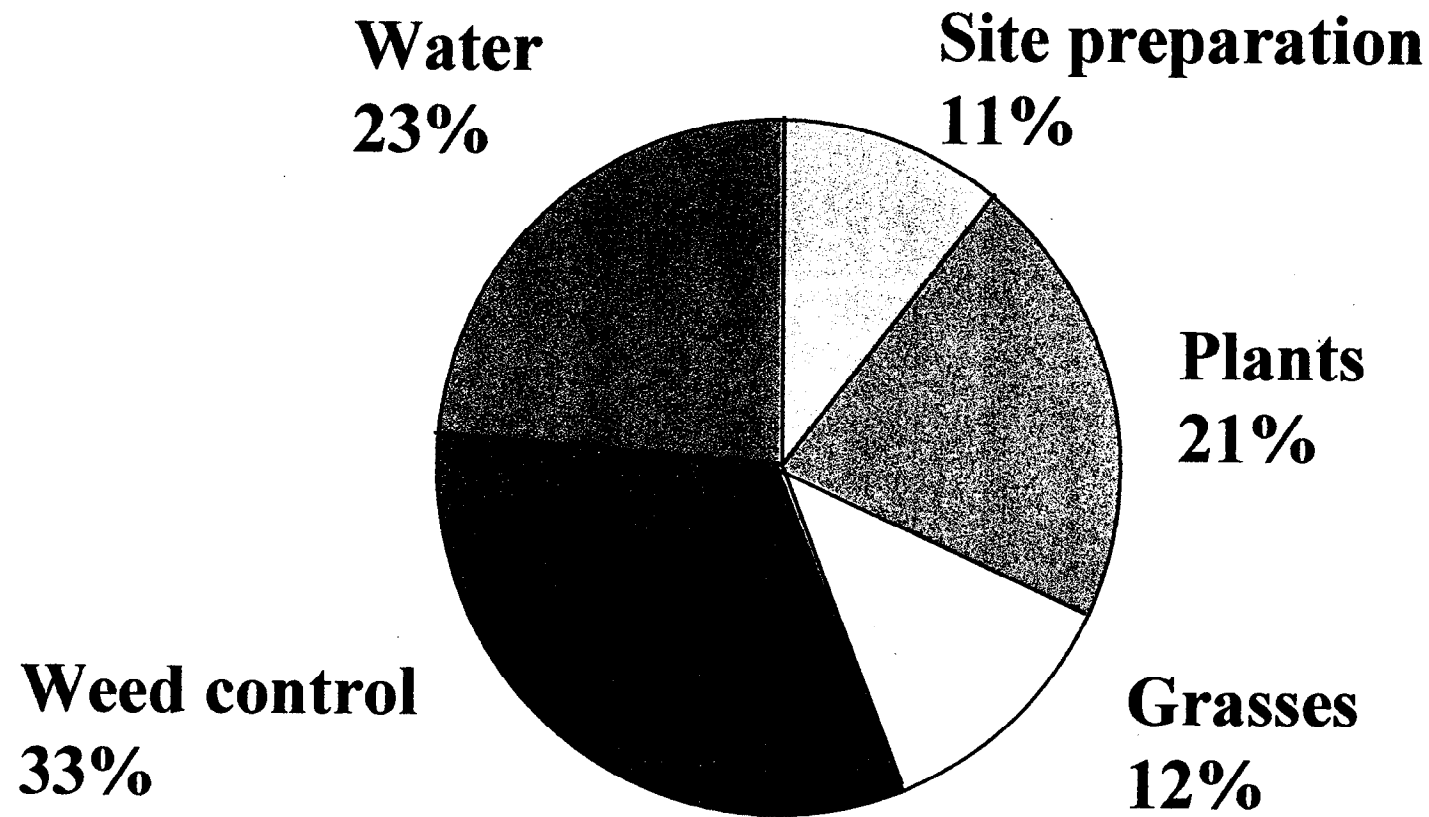


Figure 8: Recommended cost (%) of hedgerow establishment, by cost category

Table 1: Cost Estimates for Installation and Maintenance of a "Typical Hedgerow"

- Labor Costs are estimated at \$10.00/hour: Equipment Operator labor is estimated at \$9.38/hour, field labor at \$7.71/hour. The \$10.00/hour cost estimate for this project is an average of both of these labor sources, as well as other benefits provided by the employer.
- The source of hourly Equipment Costs is UCCE's "Sample Costs to Produce Processing Tomatoes in Yolo County - 1997".
- For the purpose of this study, only operating costs are used to portray Equipment Costs (Repairs, Fuel & Lube).
- This "typical" hedgerow is 1,400' long by 15' wide (approximately 1/4 acre).

Task	Date	Labor Cost	Material Cost	Equipment Cost \$/hour	Total Cost
<i>Hedgerow Installation</i>					
Hedgerow design	6-11/96	\$250.00	Survey flags: \$10.00		\$260.00
Roundup: summer weed control	8/96	\$20.00	Roundup: \$30.00	ATV+sprayer: \$10.00	\$60.00
Disc: pre-plant weed control	10/96	\$5.00		Tractor+disc: \$10.00	\$15.00
Bed preparation: plants/ grasses	10/96	\$5.00		Tractor+bedshaper: \$10.00	\$15.00
Fertilize - preplant (tablets)	11/96	\$20.00	Fertilizer: \$45.00		\$65.00
Plant trees, shrubs, and forbs	11/96	\$120.00	Plants: \$500.00		\$620.00
Plant grasses (broadcast)	11/96	\$20.00	Seed: \$275.00		\$295.00
Harrow to cover grass seed	11/96	\$10.00		ATV+harrow: \$5.00	\$15.00
Roundup: annual weed control	11/96	\$10.00	Roundup: \$15.00		\$25.00
Ronstar-G: apply in plant row	11/96	\$10.00	Ronstar-G: \$75.00		\$85.00
Install drip irrigation system	3/97	\$100.00	Drip supplies: \$200.00		\$300.00
TOTAL INSTALLATION		\$570.00	\$1,150.00	\$35.00	\$1,755.00
<i>Hedgerow Maintenance</i>					
2,4-D: Broadleaf weed control	3/97	\$10.00	2,4-D: \$20.00	ATV+sprayer: \$5.00	\$35.00
Hoe hedge plant row*	3-9/97	\$250.00			\$250.00
Irrigate 2X/month	3-10/97	\$240.00	Emitters/plugs: \$10.00		\$250.00
Mow grasses: annual weed control	4/97	\$10.00		Tractor+mower: \$10.00	\$20.00
Roundup: spot-spray	5-6/97	\$20.00	Roundup: \$15.00		\$35.00
2,4-D: spot-spray in grasses	9/97	\$10.00	2,4-D: \$10.00		\$20.00
Flame: annual grass weed control	10/97	\$10.00	Propane: \$15.00	ATV+flamer: \$5.00	\$30.00
Ronstar-G: entire hedgerow	10/97	\$20.00	Ronstar G: \$225.00		\$245.00
Plug grasses	11/97	\$20.00	Plugs: \$55.00		\$75.00
Mow grasses 2X: weed control	3-5/98	\$20.00		Tractor+mower: \$20.00	\$40.00
Hoe hedge plant row	3-5/98	\$130.00			\$130.00
Irrigate 2X/month	4-9/98	\$200.00			\$200.00
Hoe hedge plant row	6-7/98	\$120.00			\$120.00
Herbicide: 2,4-D (in grasses)	8/98	\$10.00	2,4-D: \$10.00		\$20.00
TOTAL MAINTENANCE		\$1,070.00	\$360.00	\$40.00	\$1,470.00
TOTAL COST		\$1,640.00	\$1,510.00	\$75.00	\$3,225.00

* Use of Ronstar-G in plant row reduced hoeing cost by one-half compared to non-Ronstar-G sites